



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

The primary physical education curriculum process

Citation for published version:

Jess, M, Carse, N & Keay, J 2016, 'The primary physical education curriculum process: More complex than you might think!!', *Education 3-13: International Journal of Primary, Elementary and Early Years Education*, vol. 44, no. 5, pp. 502-512. <https://doi.org/10.1080/03004279.2016.1169482>

Digital Object Identifier (DOI):

[10.1080/03004279.2016.1169482](https://doi.org/10.1080/03004279.2016.1169482)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Education 3-13: International Journal of Primary, Elementary and Early Years Education

Publisher Rights Statement:

This is an Accepted Manuscript of an article published by Taylor & Francis in Education 3-13 on 14/4/2016, available online: <http://www.tandfonline.com/10.1080/03004279.2016.1169482>.

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



The Primary Physical Education Curriculum Process: More Complex than you might think!!

Mike Jess, University of Edinburgh

Nicola Carse, University of Edinburgh

Jeanne Keay, University of the West of Scotland

This paper is currently in press and will be published in 2016 in Education 3-13: International Journal of Primary, Elementary and Early Years Education

Abstract

In this paper, we present the curriculum development process as a complex, iterative and integrated phenomenon. Building on the early work of Stenhouse (1975), we position the teacher at the heart of this process and extend his ideas by exploring how complexity thinking and ecological perspectives have helped us frame the curriculum process as self-organising, emergent, recursive and interactive. As such, we present a curriculum approach that recognises the need for teachers to concurrently develop appropriate knowledge and understanding of the learners they work with, the environment in which they work and the capacity to design learning tasks appropriate for this context. We discuss how the complexity principles of similarity and diversity offer a frame of reference to design learning tasks that bring connectedness and coherence to the primary physical education experiences of children and teachers. However, in line with Stenhouse, our ideas are not presented as a 'package of materials or a syllabus of ground to be covered' but as a complex and ecological learning process that is more 'a hypothesis testable in practice' and an invitation for critical evaluation 'rather than acceptance'.

Introduction

Internationally, the past decade has seen significant curriculum reform where centrally driven national curriculum guidelines have emerged, but responsibility for interpreting and developing the curriculum has been placed on schools and teachers (Priestley, 2010). This policy rhetoric is problematic because it positions teachers as change agents which is in direct contrast to the curriculum development approach taken over the previous two decades where centrally driven reform was foisted on teachers, arguably resulting in the erosion of their professional autonomy and creating a culture of compliance (Hargreaves and Goodson, 2006). Priestley and Biesta (2013) highlight how internationally, reflecting a trend in policy borrowing, there are many similarities between emerging models of government curriculum - outcomes driven, skills focussed and lacking in theoretical grounding. Concurrently, they question the response of the academic community, suggesting that curriculum study has

become moribund, particularly within the UK. In response to this gap within curriculum research, we seek to contribute to theory development within curriculum study by employing a complexity thinking lens to focus this paper on curriculum study in the subject area of primary physical education.

Much of the curriculum development literature raises concerns about neoliberal influences, as the emerging models of curriculum generally focus on generic skills and competencies rather than knowledge. Priestley and Biesta (2013) suggest these models are: 'driven by a narrow instrumentalism based upon economic imperatives – in other words soft skills required for the workplace rather than the sorts of powerful knowledge required to critically engage with the world' (p. 5). This focus on economic imperatives is compounded by the juxtaposition whereby these new models of curriculum place the child at the centre yet pursue a performativity agenda that is more concerned with what children should be rather than what they should know (Watson, 2010). This pervasive influence of neoliberal principles has also become a focus of academic interest within primary physical education where concerns have been raised about the increased outsourcing of curriculum delivery to commercial enterprise (Griggs, 2010). Outsourcing in this way deskills teachers and suggests outside providers are expert primary physical education teachers whilst classroom teachers are inexperienced; concurrent with Powell (2015), we argue that this notion must be challenged.

From our primary physical education research, and in line with the policy rhetoric, we see teachers as best placed to be curriculum developers (Carse, 2015). However, in agreement with Priestley and Biesta (2013), we recognise that the lack of study into the curriculum and an atheoretical approach to curriculum policy, results in teachers often lacking the knowledge and confidence to fulfil their role as curriculum developers. In an attempt to meet this challenge we have developed a framework, underpinned by ecological and complexity thinking, which identifies three elements to be addressed in order to move primary physical education forward: curriculum and pedagogy; teacher professional learning, and perceptions of physical education within schools and wider society (Jess, Keay and Carse, 2014). Within this paper we focus specifically on the curriculum and pedagogy element of this framework by exploring how complexity thinking can help us move beyond the simplistic linear conceptualisations of curriculum that currently hold sway in many parts of the world. To do

this, we first seek to conceptualise the idea of curriculum by reflecting on the work of Laurence Stenhouse (1975) who explored a more complex, and we would suggest contemporary, view of the curriculum.

Curriculum

Stenhouse (1975) problematises the concept of curriculum by highlighting the difficulties with translating policy into practice. In attempting to define curriculum, he outlines traditional definitions which focus on an 'end means' model where the purpose of curriculum is perceived as the planning of experiences to meet predetermined learning outcomes. This linear conceptualisation is at odds with our own complex perspective where we see the curriculum as a non-linear and dynamic phenomenon. Accordingly, our understanding of curriculum resonates with Stenhouse's definition, who recognises the complexity of the terminology when he presents curriculum as a:

particular form of specification about the practice of teaching and not as a package of materials or a syllabus of ground to be covered. It is a way of translating any educational idea into a hypothesis testable in practice. It invites critical testing rather than acceptance. (p. 142)

Concurrent with our own thinking, this definition emphasises a close relationship between curriculum and pedagogy. Additionally, with emphasis placed on the practice of teaching and the experimental nature of the curriculum, we suggest his definition relates to complexity thinking which emphasises the emergent, iterative and non-linear nature of the learning process (Davis and Sumara, 2006).

Further reflecting the non-linear and dynamic nature of curriculum development, Stenhouse (1975) presents the concept of the research model of curriculum development. Central to this approach is the role of the teacher as researcher and a recognition that curriculum development is an iterative process which should be judged by whether it advances knowledge rather than whether it is 'right'. Positioning the teacher as researcher, Stenhouse (1975) makes explicit the link between teaching and curriculum. Moreover, he suggests that curriculum development rests on teacher development, a proposal that reflects our own view that teacher professional development has a key role to play in supporting teachers to engage

in curriculum development (Jess et al, 2014). The way Stenhouse (1975) problematises the concept of curriculum resonates closely with the complexity theoretical lens we apply to our curriculum study and has aided our conceptualisation of curriculum. Subsequently, we now explore the key tenets of complexity thinking before considering how these relate to current practices in primary physical education and how they offer teachers the opportunity to take a more proactive role in the curriculum development process.

Complexity Thinking

We suggest that key ideas from complexity thinking connect with Stenhouse's view of curriculum, and that it has the potential to build on and extend it. In particular, we suggest that complexity thinking offers the potential to develop our understanding of the dynamic nature of curriculum and to consider the curriculum development process from a more teacher-led perspective. We take the view that complexity is best explained by considering how different systems work i.e. entities made up of many interacting parts like the earth, societies, people, trains, etc. Given the focus of this paper on education, we use humans as our example to explain complex systems. As such, the key to our understanding of complexity is the distinction between definitions of humans as either complicated or complex (Osberg, Doll & Trueit, 2009). While both types of systems are made up of many interacting elements, humans as complicated systems would act in a fixed, linear and closed-loop manner governed by laws of cause and effect and focussed on outcomes that are certain. In this scenario, humans are viewed as stable entities that have limited interaction with their environment. Conversely, as a complex system, the multiple parts of the human self-organise as they interact within their own structure and with the immediate environment (Prigogine, 1976). While this self-organising process helps support structure, order and predictability, the relationship between the parts also enables humans to produce unpredictable outcomes. These 'rich interactions' (Cilliers, 1998) help humans adapt and develop in response to ever-changing environmental demands (Morrison, 2003) and suggests they are 'inherently dynamic and transformational' (Byrne, 1998, p. 51) as they have the potential to be both structured and ordered while also being adaptable and creative.

Biesta (2008) contends that complexity helps us understand 'order, structure, regularity, causality and permanence differently' and provides 'a different understanding of those aspects of the physical and social world that are or appear to be not complex' (p. 1).

Consequently, it is important to explain how humans are able to balance the differences between notions of uncertainty and unpredictability whilst, concurrently, being able to 'achieve their integrity and maintain it over time' (Biesta, 2010, p. 5).

Therefore, before we explore how these core complexity ideas have informed our thinking on curriculum and pedagogy in primary physical education, we wish to emphasise that what follows is based upon our belief that humans are complex systems. Accordingly, and critically, while human behaviour is an interactive process it is ultimately the outcome of the human capacity to self-organise and produce emergent behaviours that have the coexisting potential to exhibit both predictability and unpredictability. As we discuss later in the paper, we suggest that this complex lens presents teachers with a frame of reference that supports their potential as curriculum developers.

Learning as a Complex Process

Building on this understanding of complexity, we have been working with this theoretical lens to inform our development work in primary physical education (Jess et al, 2014). At the heart of this work is our desire to better understand how we can more effectively support the self-organising, interactive and emergent learning process within primary physical education. To do this, we initially used ideas from ecological thinking (e.g. Newell, 1986) which, in a similar vein to complexity, purport that behaviour is a relational phenomenon emerging from the interaction between the individual, environment and tasks being undertaken (Rovengo, 2006). More recently, we have extended this thinking to incorporate complexity to help us make better sense of the iterative, non-linear, interactive and messy nature of the self-organising learning process. Consequently, as this paper progresses, we make efforts to integrate ideas from our evolving understanding of the key tenets of self-organisation and emergence, predictability and unpredictability, similarities and diversities, connectedness and nestedness, ambiguous bounding and edge of chaos, and recursive elaboration, in order to better understand this complex learning process. For this, we use primary physical education examples to consider how these complexity tenets may be used to help teachers build the capacity to make a long term contribution to the curriculum development process.

Complex Learning: A Complex Ecological Starting Point

As learners move through their lives, they meet many new situations. These new starting points can be represented as the ecological interaction between themselves as the individual, the new task and the environment. From a complexity perspective, we suggest that each new starting point is more accurately described as the interaction between the self-organising individual and the different boundaries, or constraints, created by the environment, the new task and the individual themselves. For example, when playing a game like tig/tag for the first time, young children will self-organise their bodies as they interact within many boundaries. These boundaries will include the hall space and the other children (environment), the rules of the game (task) and the child's physical, cognitive, social and emotional make up (individual). Crucially, while facing many similar boundaries, different children will respond to, or interpret, these boundaries in their own self-organising way; hence the 'ambiguous' nature of boundaries. From a learning perspective, this implies that, as all individuals begin to engage with new tasks, they will have different starting points based on their previous experiences, their current capacities and their personal interpretations of the different boundaries that frame their initial engagement with the task. Therefore, at the starting point of the learning process, this complexity view, like that of Stenhouse, moves away from the traditional notion of curriculum content being delivered to passive recipients who all learn in the same way and at the same pace.

Complex Learning: An Integrated Iterative and Emergent Process

From this complex ecological starting point, as the learning process evolves, a process of recursive elaboration takes place in which tasks are revisited in many different ways. This revisiting process is particularly important because it helps develop the deep learning that organises knowledge into a conceptual framework that can be applied and transferred across different contexts (Bransford, Brown, & Cocking, 2000). This deep learning is unlikely to happen with one-off or limited engagement in tasks as learners need to engage in deliberate practice in relation to learning goals (Keeton, Sheckley, & Griggs, 2002) so that learning 'unfolds recursively by constantly invoking and elaborating established associations' (Davis & Sumara, 2010, p 201). This focus on deep learning resonates with Stenhouse's discussion

of curriculum where he reflects that it should promote learning through a continuous process of inquiry rather than instruction of preconceived objectives. Critically, as this recursive elaboration process unfolds and deeper learning develops, the learners' emergent behaviours oscillate around the 'edge of chaos' as some responses remain inside, others move around and others extend beyond the different task, individual and environmental boundaries. Over time, therefore, these different 'edge of chaos' responses result in the learner making errors, consolidating behaviours and also challenging themselves as part of an iterative, integrated and interactive process.

Unfortunately, from the perspective of primary physical education, evidence suggests the prevailing use of the traditional multi-activity 'block' curriculum model (Kirk, 2005) is likely to provide shallow 'sampling' experiences (Cothran, 2001) that are compartmentalized, unrelated and fragmented (Rainer, Cropley, Jarvis & Griffiths, 2011). Consequently, it is unlikely children will develop the deep learning that enables them to apply and transfer their learning across different contexts. Further, the multi-activity approach often positions children as 'empty vessels' who need to be 'filled' with set knowledges (Morrison, 2008, p. 25). Kirk (2005) contends that this approach involves a behaviourist approach that sets out to produce physically educated children who reproduce specific knowledges. As such, this traditional approach to primary physical education is unlikely to offer the appropriate self-organising and iterative learning experiences that lead to deep learning. Consequently, teachers viewing the learning process in this complexity-oriented manner may need to reconsider the way they approach their 'pedagogical work' (Tinning, 2010) in primary physical education. In particular, we suggest this raises important questions about the ways teachers manipulate the task and environmental boundaries to design learning tasks that support children's deep learning as the recursive elaboration process unfolds.

However, before discussing how complexity ideas can help with the design of learning tasks, we emphasise that for teachers to offer complex learning experiences they will need to develop an understanding of the children they are supporting and the environment in which they are working (Rovengo, 2006). While a teacher's understanding of the children will develop as they work with them over time, they also need to develop background knowledge about the developing child from a holistic perspective and particularly from a motor and physical development perspective (e.g. Haywood & Getchell, 2008). This background

knowledge is important because it helps the teacher design ‘age related but not age dependent’ tasks that are likely to be ‘developmentally appropriate’ for learners. While much of this background is available in developmental and motor development textbooks, due to the limited nature of primary teachers’ initial teacher education and professional development experiences in physical education, this knowledge often fails to filter into the physical education practices in primary schools (Harris et al, 2011).

Alongside this learner-related knowledge, the teacher also needs to be aware of the nested policy system in which they work. Complexity and ecological thinking both posit that learning tasks are embedded within nested systems that are ‘simultaneously a unity, a collection of unities and a component of a greater unity’ (Davis & Sumara, 2001, p. 85). Consequently, primary physical education learning tasks are a part of sequences of learning experiences that build to create lessons, ‘blocks’ and programmes that are concurrently being influenced by school-wide, local authority and national policies (see Figure 1). However, the relationship between the elements across these nested layers is not straightforward and linear, but creates a ‘ripple effect’ as the smaller systems feed into the larger system which in turn exerts influence back into the smaller parts of the system (Morrison, 2003). Accordingly, while policy makers may believe that the implementation of education policy is a straightforward phenomenon, the reality is more complex as policy is enacted in individual schools and classrooms in many different ways and also to different degrees (Ball et al, 2012).

INSET FIGURE 1 ABOUT HERE

Designing Learning Tasks

As teachers build their understanding of key ecological components and recognise the recursive, self-organising and emergent nature of the learning process, the primary physical education learning tasks children engage with over time are an integral part of the deep learning process. To support this recursive process, teachers need to develop the appropriate knowledge to help them design learning tasks that consolidate and challenge whilst also leading children to make mistakes and move out of their ‘comfort zone’. This complex

ecological view of learning moves primary physical education teaching beyond the traditional transmission of set knowledges because it creates conditions for the design of learning tasks that are flexible and accommodate outcomes that may be predictable, but can also potentially be unpredictable. Complex learning tasks are therefore ‘dynamic, self-renewing and creative’ and bring forth ‘new’ knowledges and ways of being’ (Osberg et al., 2009, p. 225). Our conceptualisation of a curriculum constituting learning tasks thus resonates with Stenhouse’s description of curriculum as a way of translating educational ideas into a hypothesis testable in practice.

Consequently, we now discuss how we have been using this complexity lens to frame our efforts to design learning tasks in primary physical education. While we acknowledge that all of what follows has implications for teachers’ pedagogy, we concentrate on how our understanding of the relationship between the complexity concepts of *connectedness*, *similarity* and *diversity* has helped us organise the design of learning tasks that bring coherence to the children’s complex learning journey in primary physical education.

Connectedness, Similarity, Diversity and Learning Tasks

As an overarching concept, connectedness has important implications for the design of primary physical education learning tasks. Given the relational nature of humans as complex systems, making appropriate connections between key elements is central to the learning process because ‘new properties and behaviours emerge not only from the elements that constitute a system, but from the myriad connections among them’ (Mason, 2008, p. 48). However, while connections may exist they do not necessarily support the deep and coherent learning that can be applied and transferred across contexts. For example, while some connections may help support links between the actions, ideas and concepts that lead to deep learning, weaker connections will lead to the isolation or disconnection that is associated with shallow learning. It is this ‘weak’ connectivity that has become the main criticism of the multi-activity approach to the primary physical education (e.g. Griggs & Ward, 2012) because its focus on the ‘sampling’ of physical activities leads to problems with internal coherence within the subject area (Kirk, 2005) and makes it difficult for children and teachers to develop shared understandings that bring coherence to the learning experience. Subsequently, in our efforts to address the pitfalls of this fragmented model, we recognise the

need to engage in a more connected approach towards the design of learning tasks to help children and teachers identify primary physical education as a coherent and connected experience that integrates learning across their education and their lives (Penney & Chandler, 2000).

In this vein, we are attracted to the notion of primary physical education as a ‘connective specialism’ (Penney, 2008). This connective concept proposes that learning tasks, as part of the curriculum experience, focus on the core knowledge and skills that act as the catalyst to support participation in physical activity across a range of contexts (MacDonald, 2014). A connected curriculum subsequently acts as a ‘hub’ to integrate school learning with authentic experiences in ‘real life’ contexts (Rovegno, 2006). This links to ideas from situated learning and social constructivism and highlights the importance of collaboration in local settings and across the different sectors of the school system. For example, Rovegno (2006) proposes that ‘school-based learning should reflect, in substantive ways, how the subject matter is used outside school and in broader communities of practice’ (p. 264). Specifically, she recommends that authentic learning experiences should be created to contextualise children's learning within ‘real life’ scenarios. Concurrently, Kirk and Kinchin (2003) propose that situated learning enables the exploration of the relationship between different forms of culture and the impact of pedagogy on young people’s lives. Situating learning in this way captures the lived experiences of the young people, and shows how as learners they co-construct and integrate school knowledge with their lives (Kirk & Macdonald, 1998).

While the multi-activity approach may still dominate, there is evidence of efforts being made to develop a more connected approach to primary physical education. For example, and as we discuss later in the paper, our own research has reported on the work of primary class teachers who are underpinning their curriculum endeavours with a more connected approach focussed on the idea of core learning and the signposting of links between physical education activities (Jess, Atencio and Carse, 2012; Carse, 2015). Another example of connectedness comes from Quay and Peters (2008) who focussed on making holistic connections between aspects of the primary physical education curriculum by overtly seeking to connect aspects of skill and fitness, personal and social development and physical activity. To do this, they created a nested curriculum model that included fundamental motor skills, creative games

making, Teaching Games for Understanding (TGfU), Sport Education and the Teaching Personal and Social Responsibility Approach as a connected package to provide children with the conceptual understanding and social ability to organise their own games beyond the PE setting.

With connectivity and coherence as key goals, we have recognised how our understanding of the co-existing complexity concepts of similarity and diversity now play a critical role in helping us design tasks focussed on deep, coherent and transferable learning. On the one hand, similarities are the inward-looking, more common features that bring order and coherence to complex systems. For example, similarities help create the 'sameness' that contributes to the coherence of the children's functioning by enabling interactions to take place between their different internal parts, but also externally with the broader nested system. In primary physical education, similarity echoes with recent calls to physically educate children more holistically (Bailey et al, 2009) by 'going beyond simply developing pupils' physical skills and further educating them in line with a broader understanding of learning, development and identity.' (Atencio et al, 2014, p.245). By focussing on these similarities, primary physical education experiences are likely to be more coherent as they help children engage in learning experiences that help them recognise, and share, similarities across learning tasks and across different contexts e.g. generic attacking and defending principles are a key feature of TGfU that transfer learning across different games.

Conversely, the diversities in complex systems represent the '*range and contours*' of the differences across the system (Davis, Samura & Luce-Kempler, 2008) and are the outward-looking aspects that support adaptable and creative actions in response to the dynamics across a range of contexts. In primary physical education contexts diversities highlight how children will 'require diverse and unexpected responses in terms of physical movement, cognitive reasoning and social interaction' (Chow & Atencio, 2012, p. 2). This point is critical because children rarely respond to recurring situations in the same way and, consequently, need to develop the diverse behaviours that enable them to be adaptable and creative across physical activity contexts. This need for diversity is particularly apparent in team games but is important in almost all other activities.

While similarities and diversities represent contrasting features of complex systems, they are also complementary and often operate reciprocally to maintain the effective functioning and coherence of the learning system (Davis, Sumara & Luce-Kempler, 2008). For example, as the learning process unfolds recursively, too much similarity results in too much ‘sameness’ and impacts negatively on the system’s ability to develop the deep learning that enables it to be adaptable in different contexts. This problem is apparent in sport teams who have all been ‘trained’ to respond to situations in exactly the same way. Alternatively, while diversities are the key to adaptability, too much diversity leads to a lack of coherence between the system’s parts and is likely to lead to the shallow learning that limits efficiency and adaptability. As has been discussed, the ‘sampling’ approach to traditional primary physical education is an example of too much diversity leading to an overall experience that lacks coherence and connection.

Therefore, in order to design coherent primary physical education programmes, we propose that teachers will need the capacity to design an appropriate mix of learning tasks that focus on the similarities that bring order within and across different physical activity contexts while concurrently offering diverse experiences that support children’s efficient, adaptable and creative learning. As many of the examples presented in this paper demonstrate, however, primary physical education is often aligned to a more traditional curriculum view focussed on the direct transmission of set knowledges within unrelated ‘blocks’ of physical activity. Consequently, we now offer a summary of the approach we have been developing to reframe the design of those learning tasks that are a key part of the curriculum process in primary physical education. While we acknowledge the summary may be brief, the intention of this paper has been to conceptualise our thinking about the curriculum process and we intend to explore the applied possibilities in future texts.

Complexity Thinking and Primary Physical Education: Core Learning and Applications

In our attempts to enact this idea of a complexity-informed ‘connective specialism’ we have experimented over many years with numerous iterations of primary physical education learning experiences focussed on two interrelated elements: core learning and applications (see Jess, 2012). Central to this work has been an ongoing engagement with the design of

core learning tasks based on three key considerations: they are situated within teachers' ecological context, have their basis in the co-existence of learning experiences focussed on a combination of generic similarities and diversities and aim to develop the deep connective learning that enables application and transfer across different physical activity contexts.

From a practical perspective, our efforts to design complexity-informed core learning curricula have generally concentrated on the early years and are evident in the development of Early Moves (Jess and McIntyre, 2009), Basic Moves (Jess, Dewar and Fraser, 2004) and Start to Move (Keay & Spence, 2012) approaches. Focussed on children's evolving movement foundation, these approaches concentrate on a range of learning experiences that support the learner's ability to consistently perform basic movements in ways that display degrees of technical efficiency whilst also demonstrating adaptability and creativity. Crucially, we emphasise that while the capacity to exhibit movement efficiency across different activity contexts may be necessary for successful participation, we recognise that without adaptability and creativity children's foundation is likely to become a series of narrow movement patterns that limit their ability to respond effectively to different situations. As such, this is why core learning has its focus on the generic similarities and differences that prepare children for the varied responses needed in different games, sports, dance and other physical activities.

Towards this end, our applied work has focussed on the development of an early years core learning framework that consists of key balance and coordination components, generic basic movements and the cognitive, social and emotional movement concepts that together create an evolving 'connective' foundation that develops across the primary school years (Jess, 2012). We stress, therefore, that our vision of core learning is not presented as a set of pre-programmed 'building blocks' but embodies complexity-informed learning experiences that seek to scaffold the non-linear nature of children's core learning over time. Indeed, we suggest that core learning is itself a complex phenomenon and represents an important step forward for primary physical education because it acknowledges the complex nature of the learning process and moves beyond more simplistic notions of fundamental motor skills.

Further, while we see complex core learning as a central component of future primary physical education curricula we recognise its importance is related to how it is applied and transferred across a wide range of physical activity contexts. Consequently, we have termed the different physical activity contexts in which children apply and transfer their core learning as applications (Jess, Haydn-Davis and Pickup, 2007) and recognise that these have close links to much of the recent thinking about models-based practice (e.g. Kirk, 2013). These applications are particularly significant because core learning experiences should not be developed in isolation but in contexts that are increasingly connected to children's lives within and beyond the gymnasium. Similarly informed by complexity principles, we therefore see applications as the transitional mechanisms between children's evolving core learning and their participation across the many facets of their lives. As such, in an integrated and recursive fashion, core learning and applications contribute to the creation of physical education experiences that are both connected and coherent. For a more detailed description of core learning and applications please see Jess, 2012.

Conclusion

In this paper, we have approached the curriculum development process as a complex, iterative and integrated phenomenon. Concurrent with Stenhouse (1975), we have positioned the teacher at the heart of this process, but have extended his work by exploring how ideas from ecological and complexity thinking have helped us frame the curriculum process as self-organising, emergent, recursive and interactive. To this end, we have presented an approach that highlights the need for teachers to concomitantly develop the appropriate knowledge and understanding of the learners they work with, the immediate and nested environment in which they work and the capacity to design learning tasks appropriate for their context. Specifically, we have considered how the complexity principles of similarity and diversity have helped us frame the designing of learning tasks that bring both connectedness and coherence to the physical education experiences of children and teachers. As we reflect on the work of Stenhouse, we do not present these ideas as a 'package of materials or a syllabus of ground to be covered' but explore curriculum as a complex and ecological learning process that offers teachers the opportunity to play a more significant role in the curriculum development process. However, in agreement with Stenhouse, we do not present our own

recursive efforts as finished products more as ‘a hypothesis testable in practice’ and an invitation for critical evaluation ‘rather than acceptance’.

References

- Atencio Matthew, Jia Yi Chow, Wee Keat Clara Tan and Lee Chang Yi Miriam, 2014. "Using a complex and nonlinear pedagogical approach to design practical primary physical education lessons." *European Physical Education Review* 20 (2): 244–263. doi: 10.1177/1356336X14524853.
- Bailey, Richard. 2005. "Evaluating the relationship between physical education, sport and social inclusion." *Educational Review* 57 (1): 71-90, doi: 10.1080/0013191042000274196.
- Ball, Stephen, Meg Maguire and Annette Braun. 2012. *How schools do policy: policy enactments in secondary schools*. London: Routledge.
- Biesta, Gert. 2008. "Five theses on complexity reduction and its politics." Paper presented at the *Annual Meeting of the American Educational Research Association*, New York, USA, March 24-28 March.
- Biesta, Gert. 2010. "Five theses on complexity reduction and its politics." In *Complexity Theory and the Politics of Education*, edited by Deborah Osberg and Gert Biesta, 5 - 15. Rotterdam: Sense.
- Bransford, John, Ann Brown and Rodney Cocking. 2000. *How people learn: Brain, mind, and experience & school*. Washington, DC: National Academy Press.
- Byrne, David. 1998. *Complexity theory and the social sciences*. London: Routledge.
- Carse, Nicola. 2015. "Primary teachers as physical education curriculum change agents." *European Physical Education Review* 21 (3): 309-324. doi: 10.1177/1356336X14567691.
- Chow, John and Matthew Atencio. 2012. "Complex and nonlinear pedagogy and the implications for physical education." *Sport, Education and Society* 19 (8): 1034-1054. doi: 1080/13573322.2012.728528
- Cilliers, Paul. 1998. *Complexity and postmodernism*. London: Routledge.
- Cothran, Donetta. 2001. "Curricular Change in Physical Education: Success stories from the front line." *Sport, Education & Society*, 6 (1): 67-79. doi: 10.1080/713696038.
- Davis, Brent and Dennis Sumara. 2001. "Learning communities: Understanding the workplace as a complex system." *New Directions for Adult and Continuing Education* 92: 85–95. doi:10.1002/ace.43
- Davis, Brent and Dennis Sumara. 2006. *Complexity and education: Inquiries into learning, teaching, and research*. London: Lawrence Erlbaum.

Davis, Brent and Dennis Sumara. 2010. "Enabling constraints: Using complexity research to structure collective learning." In *More teaching games for understanding: Moving globally* edited by Joy Butler and Linda Griffin, 105–120. Champaign, IL: Human Kinetics.

Davis, Brent, Dennis Sumara and Rebecca Luce-Kapler. 2008. *Engaging minds: Changing teaching in complex times* (2nd ed.). New York: Routledge.

Griggs, Gerald. 2010. "For sale—primary physical education.£20 per hour or nearest offer." *Education 3–13* 38 (1): 39-46. doi: 10.1080/03004270903099793

Griggs, Gerald and Gavin Ward. 2012. "Physical education in the UK: Disconnections and reconnections." *Curriculum Journal* 23 (2): 207–229. doi:10.1080/09585176.2012.678500.

Hargreaves, Andy and Ivor Goodson. 2006. "Educational change over time? The sustainability and nonsustainability of three decades of secondary school change and continuity." *Educational administration quarterly* 42 (1): 3-41. doi: 10.1177/0013161X05277975.

Harris, Jo, Lorraine Cale and Hayley Musson. 2011. "The effects of a professional development programme on primary school teachers' perceptions of physical education." *Professional Development in Education* 37 (2): 291–305. doi:10.1080/19415257.2010.531973.

Haywood, Kathleen and Nancy Getchell. 2009. *Life span motor development (5th ed.)*. Champaign, IL: Human Kinetics.

Jess, Mike. 2012, The Future of Primary PE: A 3-14 Developmental and Connected Curriculum. In Gerald Griggs (Ed.), *An Introduction to Primary Physical Education*. Routledge: London.

Jess, Mike and Jan McIntyre, 2009. "Developmentally Appropriate Physical Education in the Early Years", *Nursery World*, 28th January 16-17

Jess, Mike, Ian Pickup and Dominic Haydn-Davies. 2007. "Physical Education in the Primary School: Developmental, Inclusive and Connected Future", *Physical Education Matters*, 2(1), 16-20

Jess, Mike, Kay Dewar and Gordon Fraser. 2004. "Basic Moves: Developing a Foundation for Lifelong Physical Activity" *British Journal of Teaching in Physical Education*, 35(2), 23-27.

Jess, Mike, Mathew Atencio and Nicola Carse. 2012. "Introducing conditions of complexity in the context of Scottish physical education." In *Complexity thinking in physical education: Reframing curriculum, pedagogy and research* edited by Alan Ovens, Tim Hopper and Joy Butler, 27–41. London: Routledge.

Jess, Mike, Jeanne Keay and Nicola Carse 2014. "Primary physical education: a complex learning journey for children and teachers." *Sport, Education and Society*. Advance online publication. doi:10.1080/13573322.2014.979142

Keay, Jeanne. 2011. *Supporting Key Stage 1 Physical Education*, Reports for Top Foundation: Youth Sport Trust, Loughborough

Keeton, Morris, Barry Sheckley and James Griggs. 2002. *Efficiency and effectiveness in higher education*. Dubuque, Iowa: Kendall/Hunt Publishing Company.

Kirk, David. 2005. "Physical education, youth sport and lifelong participation: The importance of early learning experiences." *European Physical Education Review* 11 (3): 239–255. doi: 10.1177/1356336X05056649.

Kirk, David. 2013. "Educational Value and Models-Based Practice in Physical Education." *Educational Philosophy and Theory*, 45(9): 973–986. doi: 10.1080/00131857.2013.785352

Kirk, David and Gary, Kinchin. 2003. "Situated learning as a theoretical framework for Sport Education." *European Physical Education Review* 9 (3): 221–236. doi: 10.1177/1356336X030093002.

Kirk, David and Doune, Macdonald. 1998. "Situated Learning in Physical Education." *Journal of Teaching in Physical Education* 17 (3): 376–387.

MacDonald, Doune. 2014. "Is global neo-liberalism shaping the future of physical education?" *Physical Education and Sport Pedagogy* 19 (5): 494–499. doi: 10.1080/17408989.2014.920496

Mason, Mark. 2008. "What is complexity theory and what are its implications for educational change?" *Education Philosophy and Theory* 40: 135–149. doi: 10.1111/j.1469-5812.2007.00413.x

Morrison, Keith. 2003. "Complexity theory and curriculum reforms in Hong Kong." *Pedagogy, Culture and Society* 11 (2): 279–302. doi:10.1080/14681360300200174.

Morrison, Keith. 2008. "Educational philosophy and the challenge of complexity theory." *Education Philosophy and Theory*, 40 (1): 19–34. doi:10.1111/j.1469-5812.2007.00394.x

Newell, K. 1986. "Constraints on the development of coordination." In *Motor development in children: Aspects of coordination and control* edited by M. Wade and H. T. A. Whiting, 295–317. Amsterdam: Elsevier.

Osberg, Deborah, William Doll and Donna Trueit. 2009. "Editorial: Limiting complexity." *Complicity: An International Journal of Complexity & Education*, 6 (2): iii–x.

Penney, Dawn. 2008. "Playing a political game and playing for position: Policy and curriculum development in health and physical education." *European Physical Education Review* 14 (1) 33–49. doi:10.1177/1356336X07085708.

Penney, Dawn and Mike Jess. 2004. "Physical education and physically active lives: A lifelong approach to curriculum development." *Sport, Education and Society* 9 (2): 269–287. doi:10.1080/1357332042000233985.

Powell, Darren. 2015. "Assembling the privatisation of physical education and the 'inexpert' teacher." *Sport, Education and Society* 20 (1): 73-88. doi: 10.1080/13573322.2014.941796.

Priestley, Mark. 2010. "Curriculum for Excellence: transformational change or business as usual?" *Scottish Educational Review* 42(1): 23-36.

Priestley, Mark, and Gert Biesta. 2013. *Reinventing the curriculum: New trends in curriculum policy and practice*. London: Bloomsbury.

Prigogine, Ilya. 1976. "Order through fluctuations: Self organization and social system." In *Evolution and consciousness: Human systems in transition* edited by Erich Jantsch and Conrad Waddington, 93–130. Reading, MA: Addison-Wesley.

Quay, John and Jacqui Peters. 2008. "Skills, strategies, sport, and social responsibility: Reconnecting physical education." *Journal of Curriculum Studies* 40 (5): 601–626. doi:10.1080/00220270801886071.

Rainer Paul, Brendan Cropley, Stuart Jarvis and Rob Griffiths. 2012. "From policy to practice: the challenges of providing high quality physical education and school sport faced by head teachers within primary schools." *Physical Education and Sport Pedagogy* 17 (4): 429-446. doi: 10.1080/17408989.2011.603125.

Rovengo, Inez. 2006. "Situated perspectives on learning." In *The handbook of physical education* edited by David Kirk, Doune Macdonald and Mary O'Sullivan, 262–274. London: SAGE.

Stenhouse, Laurence. 1975. *An Introduction to Curriculum Research and Development*. London: Heinemann Educational.

Tinning, Richard. 2010. *Pedagogy and human movement. Theory, practice, research*. London: Routledge.

Watson, Cate. 2010. "Educational policy in Scotland: inclusion and the control society." *Discourse: studies in the cultural politics of education* 31 (1): 93-104. doi: 10.1080/01596300903465443